

FORM PTO-1390 (Modified)
(REV 11-98)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

R.36045

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09/856910

INTERNATIONAL APPLICATION NO.

PCT/DE 00/03195

INTERNATIONAL FILING DATE

14 SEPTEMBER 2000

PRIORITY DATE CLAIMED

30 SEPTEMBER 1999

TITLE OF INVENTION

DEVICE FOR ACTING ON A FLOWING GAS WITH A REACTANT

APPLICANT(S) FOR DO/EO/US

HUPFELD, Bernd

MAY 3 0 2001

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
- a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
- b. ☐ has been transmitted by the International Bureau.
- c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
- a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
- b. ☐ have been transmitted by the International Bureau.
- c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
- d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Transmittal Sheets in Duplicate w/fees Charged
to Dep. Acct. 07-2100
Copy of German Text Application w/1 Sheet Drawing
Translation of German Text Application w/1 Sheet Drawing
Preliminary Amendment
Copies of PCT/RO/101, PCT/ISA/210 and 220
Executed Declaration (Not Enclosed At This Time)
Assignment to Robert Bosch GmbH (Not Enclosed At This Time)

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 09/856910		INTERNATIONAL APPLICATION NO. PCT/DE 00/03195		ATTORNEY'S DOCKET NUMBER R.36045	
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21. The following fees are submitted:				CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :					
<input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO				\$1,000.00	
<input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO				\$860.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO				\$710.00	
<input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)				\$690.00	
<input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)				\$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input checked="" type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				\$130.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	12 - 20 =	0	x \$18.00	\$0.00	
Independent claims	- 3 =	0	x \$80.00	\$0.00	
Multiple Dependent Claims (check if applicable). <input type="checkbox"/>				\$0.00	
TOTAL OF ABOVE CALCULATIONS =				\$990.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable). <input type="checkbox"/>				\$0.00	
SUBTOTAL =				\$990.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).				\$0.00	
TOTAL NATIONAL FEE =				\$990.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). <input type="checkbox"/>				\$0.00	
TOTAL FEES ENCLOSED =				\$990.00	
				Amount to be: refunded	\$
				charged	\$

☐ A check in the amount of _____ to cover the above fees is enclosed.

☒ Please charge my Deposit Account No. **07-2100** in the amount of **\$990.00** to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **07-2100** A duplicate copy of this sheet is enclosed.

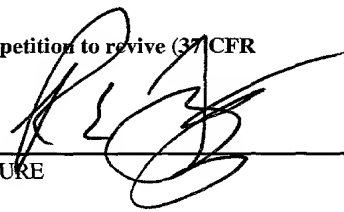
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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SIGNATURE

Ronald E. Greigg

NAME

31,517

REGISTRATION NUMBER

30 MAY 2001

DATE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Bernd Hupfeld

Based on PCT/DE 00/03195

For: Device For Acting On A Flowing Gas With A Reactant

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, between the title and first line of the specification, insert the following:

--CROSS-REFERENCE TO RELATED APPLICATIONS

BACKGROUND OF THE INVENTION--;

line 2, delete "Prior Art" and insert --Field of the Invention--;

lines 4 and 5, delete ", according to the preamble to claim 1";

between lines 5 and 6, insert --Description of the Prior Art--.

Page 2, line 1, after "of" insert --bends or--;

between lines 22 and 23, insert --OBJECTS AND SUMMARY OF THE
INVENTION--;

line 23, delete "Therefore the" and insert --A primary--.

Page 3, delete lines 5 and 6;

delete lines 17 and 18;

line 19, delete "particularly".

Page 5, between lines 11 and 12, insert BRIEF DESCRIPTION OF THE DRAWINGS--;

line 12, delete "invention will now be explained in detail in" and insert --foregoing and other features of the invention will be apparent from the detailed description contained below, taken in --;

line 13, delete "drawings." and insert --, in which:--;

between lines 17 and 18, insert --DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

Page 6, line 22, delete "downstream" and insert --upstream--.

Page 8, after line 3, insert the following paragraph:

--The foregoing relates to preferred exemplary embodiments of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.--.

Page 9, line 1, delete "Claim" and insert --I Claim--.

IN THE CLAIMS

Please cancel claims 1-4 and add new claims 5-12.

5. In a device for acting on a flowing gas, in particular an exhaust flowing in a conduit, with a reactant, in particular a reducing agent, wherein the device has a supply tube embodied in its conduit wall, which tube has openings (2) via which

reactant introduced into the supply tube can be introduced into the flowing gas, the improvement comprising a throttle disposed upstream of the openings (2) in the supply tube (1).

6. The device according to claim 5, wherein the tube (1) has a first region (1a) extending essentially perpendicular to the flow direction of the flowing gas and a second region (1b) extending essentially parallel to the flow direction of the flowing gas, wherein the openings (2) are embodied in a section (X) of the second region (1b) downstream of the throttle.

7. The device according to claim 5, wherein a number of openings (2) are provided, which are distributed uniformly around the circumference of the tube (1).

8. The device according to claim 6, wherein a number of openings (2) are provided, which are distributed uniformly around the circumference of the tube (1).

9. The device according to claim 5, wherein the throttle (3) has a throttle opening (3a) disposed in the center of the tube (1).

10. The device according to claim 6, wherein the throttle (3) has a throttle opening (3a) disposed in the center of the tube (1).

11. The device according to claim 7, wherein the throttle (3) has a throttle opening (3a) disposed in the center of the tube (1).

12. The device according to claim 8, wherein the throttle (3) has a throttle opening (3a) disposed in the center of the tube (1).

IN THE ABSTRACT

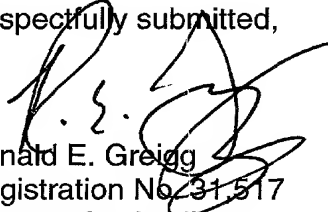
Please substitute the attache Abstract of the Disclosure for the abstract as original filed.

REMARKS

The above amendments are being made to place the application in better condition for examination.

Entry of the amendment is respectfully solicited.

Respectfully submitted,


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ABSTRACT OF THE DISCLOSURE

A device for acting on a flowing gas, in particular an exhaust, with a reactant, in particular a reducing agent, wherein the device has a supply tube embodied in its wall, which tube has openings via which reactant introduced into the supply tube can be introduced into the flowing gas, characterized by means of a throttle disposed upstream of the openings in the supply tube.

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JC18 Rec'd PCT/PTO 3 0 MAY 2001

Device for Acting on a Flowing Gas with a Reactant

5 The current invention relates to a device for acting on a flowing gas, in particular an exhaust, with a reactant, in particular a reducing agent, according to the preamble to claim 1.

In order to reduce emissions levels in motor vehicles, extensive advances have been made in catalytic converter technology, in particular in order to reduce nitrogen oxides in exhaust. Reduction catalytic converters have turned out to be particularly promising in this connection.

15 As a device for aftertreatment of exhaust, for example, EP-A-0 381 236 has disclosed a system in which ammonia or urea is added to the exhaust as a reducing agent. In this known system, the reducing agent is sprayed via an injection valve into a premixing chamber which feeds into the exhaust pipe leading to the reduction catalytic converter. In a device of this kind, in order to introduce a reducing agent into an exhaust pipe section of an internal combustion engine, which pipe leads to a reduction catalytic converter, the premixing
20 chamber constitutes a reducing agent line that feeds into the exhaust pipe.

Although a part of the reducing agent is atomized in the mixing chamber or mixing section, a wall film forms. If the atomizing tube depicted there is used, an uneven wall film

decomposition occurs in the vicinity of turns - particularly when small reducing agent quantities are used. This is due to the fact that in the inner and outer regions of the tube bend, there are different flow speeds of the air, exhaust, or other carrying medium which is used to transport the reducing agent. A favorable equidistribution of the reducing agent in the entire operating range of the system is therefore not assured. This results in poorer conversion rates in the catalytic converter.

DE-A-1 196 25 447 has disclosed a device for aftertreatment of exhaust of an internal combustion engine in which in order to promote the action of a subsequent reduction catalytic converter, fuel is admeasured as a reducing agent by means of a metering valve and is introduced into the exhaust valve via an evaporating device. The evaporating device is a metal sleeve which is provided with a glow element and has a through opening on its end face, through which the evaporated reducing agent is introduced into the exhaust flow. In this system, the evaporation of the reducing agent is in fact thermally encouraged, but this embodiment is technically difficult to achieve and requires a high expenditure of energy to heat and evaporate the reducing agent.

Therefore the object of the invention is to produce a device for acting on a flowing gas, in particular an exhaust, with a reactant, in particular a reducing agent, with which a favorable aerosol formation occurs in the greatest possible

characteristic field range so that the overall efficiency of the reaction system, in particular of a catalytic converter system, is increased and so that lower NO_x emissions, for example, can be achieved.

5 This object is attained by means of a device with the characteristics of claim 1.

10 The device according to the invention makes it possible for a flowing gas, in particular an exhaust, to be acted on with reactants or reducing agents more uniformly than is possible with conventional designs. The more uniform reactant or reducing agent distribution that is assured according to the invention makes it possible, for example in catalytic converter systems, to achieve significantly better conversion rates than in conventional systems, even with the introduction of relatively small reducing agent quantities into an exhaust to be aftertreated catalytically.

Advantageous embodiments of the device according to the invention are the subject of the dependent claims.

20 According to a particularly preferred embodiment of the device according to the invention, the means for uniformly distributing the reactant are embodied as screens or throttles inserted into the tube. A screen or throttle of this kind can be obtained for very little expense and can easily be inserted

into a desired location in the supply or metering tube of the reactant.

According to a suitable modification of the device according to the invention, the supply tube has a first region extending essentially perpendicular to the flow direction of the flowing gas and a second region extending essentially parallel to the flow direction of the flowing gas, wherein the openings via which the reactant can be introduced from the supply tube into the flowing gas are embodied in a section of the tube wall of the second region and the means for uniform distribution of the reactant are provided immediately upstream of this section. It turns out to be simple to mount a supply tube of this form in an exhaust line through which an exhaust flows. The addition of the reducing agent, for example in an exhaust system, takes place, for example, in commercial vehicles with compressed air support, i.e. the reducing agent to be supplied is transported through the supply tube by means of compressed air. Particularly with small reducing agent quantities, different flow speeds at the turning point of the supply tube (transition between the first and second region of the supply tube) lead to an uneven wall film decomposition of the reducing agent. Usually in the past, the reducing agent only came out of a part of the openings at the end of the supply tube, as a result of which a favorable equidistribution in the entire operating range of the system was no longer assured. According to the invention, this uneven wall film decomposition is now compensated for by virtue of the fact

that, for example with the use of a screen or throttle, the reducing agent is once again concentrated in the center of the spray tube and then, driven by the above-mentioned compressed air, can be introduced into the exhaust flow uniformly in the form of an aerosol by means of the outlet bores.

Suitably, a number of openings are provided, which are distributed uniformly around the circumference of the tube. The cooperation of the means for uniform distribution of the reactant with such uniformly disposed openings permits reactants to act on a flowing gas in a particularly uniform manner.

The invention will now be explained in detail in conjunction with the accompanying drawings.

Fig. 1 shows a schematic, sectional side view of a preferred embodiment of the device according to the invention and

Fig. 2 shows an enlarged view of the region X in Fig. 1.

In Fig. 1, the wall of an exhaust pipe section 10 is shown in which exhaust from an internal combustion engine is conveyed to a reduction catalytic converter. The flow direction of the exhaust is indicated by the arrow p. A supply tube 1 feeds into the exhaust pipe section 10 and reducing agent from a reducing agent tank (not shown) can be introduced

into the exhaust pipe section via this supply tube. In addition to hydrocarbons, for example diesel fuels among others, in particular urea-water solutions can be considered for use as the reducing agent and can be introduced into the supply line, for example by means of an injection nozzle, a gasifying device, or other metering devices.

In an intrinsically conventional manner, the supply line 1 inside the exhaust pipe has a first region 1a extending essentially perpendicular to the flow direction of the exhaust, a second region 1b extending essentially parallel to the flow direction of the gas, and a bending region 1c that connects the regions 1a and 1b. The region 1b of the supply tube is suitably disposed in the center of the exhaust pipe and extends in a direction that corresponds at least approximately to the exhaust flow in the exhaust pipe.

At the downstream end of the supply tube 1, there is a section labeled X, which is shown in an enlarged scale in Fig. 2. In this region X, embodied on the circumference of the wall of the tube section 1b, the supply tube 1 has a number of openings 2 via which reducing agent can travel from the supply tube 1 into the exhaust pipe. Before these openings 2 in the downstream direction, there is a throttle 3, which has a throttle opening 3a in the center. The function of this throttle 3 in operational connection with the openings 2 will be explained below.

The supply tube 1 is fastened to the wall 10 of the exhaust pipe, for example by means of a screw connection 11.

When the atomizing tube depicted is used, an uneven wall film decomposition occurs in the vicinity of the bend - particularly when small reducing agent quantities are used. This is due to the fact that in the inner and outer regions of the tube bend, there are different flow speeds of the air, exhaust, or other carrying medium which is used to transport the reducing agent. A favorable equidistribution of the reducing agent in the entire operating range of the system is therefore not assured. This results in poorer conversion rates in the catalytic converter.

The throttle 3 serves to concentrate the wall film in the center of the spray tube, as a result of which the effect of interrupted wall films can be compensated for. The reducing agent concentrated in the center of the tube 1 by means of the throttle 3 is pushed through the central opening 3a of the throttle by means of the compressed air mentioned above, which causes the reducing agent to uniformly act on the openings 2.

In summary it is clear that through the use of the throttle 3, the quality of the aerosol formation is sharply improved in comparison to conventional embodiments so that the total efficiency of the system, i.e. the NO_x reduction can be improved in comparison to conventional embodiments. The system can be adjusted to different requirements or engines by means

of parameters relating to the arrangement, size, and number of openings 2 and relating to the dimensions of the central opening 3a of the throttle 3.

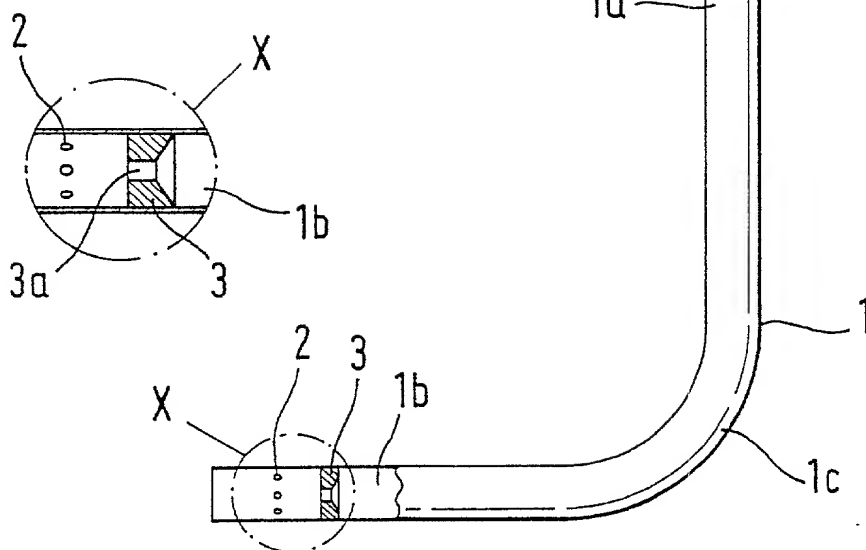
Claims

1. A device for acting on a flowing gas, in particular an exhaust, with a reactant, in particular a reducing agent, wherein the device has a supply tube embodied in its wall, which tube has openings (2) via which reactant introduced into the supply tube can be introduced into the flowing gas, characterized by means of a throttle disposed upstream of the openings (2) in the supply tube (1).

2. The device according to claim 1, characterized in that the tube (1) has a first region (1a) extending essentially perpendicular to the flow direction of the flowing gas and a second region (1b) extending essentially parallel to the flow direction of the flowing gas, wherein the openings (2) are embodied in a section X of the second region (1b).

3. The device according to one of claims 1 or 2, characterized in that a number of openings (2) are provided, which are distributed uniformly around the circumference of the tube (1).

4. The device according to one of the preceding claims, characterized in that the throttle (3) has a throttle opening (3a) disposed in the center of the tube (1).



Docket No.
R.36045

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

DEVICE FOR ACTING ON A FLOWING GAS WITH A REACTANT

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on 14 SEPTEMBER 2000 ✓ as United States Application No. or PCT International Application Number PCT/DE 00/03195 ✓ and was amended on _____

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not Claimed

1 99 46 901.6 ✓
(Number)

(Number)

(Number)

GERMANY ✓
(Country)

(Country)

(Country)

30 September 1999 ✓
(Day/Month/Year Filed)

(Day/Month/Year Filed)

(Day/Month/Year Filed)

☐
☐
☐

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Ronald E. Greigg - Registration No. 31,517

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Full name of sole or first inventor	
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Sole or first inventor's signature	Date
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Full name of second inventor, if any	
Second inventor's signature	Date
Residence	
Citizenship	
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